



NATIONAL STANDARDS OF PUERTO RICO TEMPERATURE METROLOGY LABORATORY

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Calibration Report

EDACI

Cnel Lynch 2684 San Justo, Buenos Aires, Argentina

Description: SPRT
Manufacturer: ACCUMAC
Serial Number: 1621255
ID Number: N/A

Test Number: TEM18-1056B
Model Number: AM1860-25
Received Date: 11/05/18
Calibration Date: 11/21/18
Next Due: 11/21/19

B. Sosa
Calibration Technician

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Technical Manager

INTRODUCTION

This report covers the operations used to assign temperature deviation of the thermometry equipment identified in the first page of this document. It includes a brief description of the measurement methods and procedures which were used, measurement data, and calibration analysis. The results are presented in several formats: Standard Reading, Thermometer Reading and uncertainties value.

Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results (1994). The uncertainty calculations are applied for temperature comparisons. The uncertainty is evaluated either by Type A or Type B method of evaluation. Type A evaluation is based on a statistical analysis of a series of measurements whereas Type B evaluation is based on scientific judgment using all the relevant information available.

The tolerance test is a verification that the W value at TP-Hg or MP-Ga for test thermometer is correct or not within the maximum permissible errors according to ITS-90 [1] document.

REFERENCES

The following references are suggested for general information concerning the temperature measurement process:

1. H. Preston-Thomas, The international Temperature Scale of 1990(ITS-90), Metrologia 27, 3-10 (1990)
2. JCGM 100:2008. "Evaluation of measurements data - Guide to the expression of uncertainty in measurements". First Edition, September 2008.

METHODOLOGY

Thermometers are calibrated by comparison method against a certified SPRT using defined fixed points. The SPRT shall be used before and after the Thermometer under Calibration in the Fixed Point Cell in order to verify the cell plateau.

The measure of uncertainty intended to meet the requirements is termed **expanded uncertainty**, suggested symbol U , and is obtained by multiplying $u_c(y)$ by a covered factor, suggested symbol k . The value of the coverage factor k is determined on the basis of the desired level of confidence to be associated with the interval defined by $U=ku_c$. A coverage factor of $k=2$ allows for a confidence interval of 95.54 %.

UNCERTAINTY

The uncertainty calculations are based on

"No statement of compliance with specifications is made or implied on this certificate. However, measurement results are reviewed, where applicable, to establish where any measurement result exceeds the manufacturer's specifications. Measurement result greater than limits of error are indicated by * "



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EDACI

Calibration Range: -196 to 420 °C

Test Number: TEM18-1056B

Cnel Lynch 2684 San Justo, Buenos Aires, Argentina

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National Standard of Puerto Rico certifies that the all standards used meets or exceeds all specifications as stated in the references procedures. It has been calibrated using measurements standards traceable to the National Institute of Standard and Technology (NIST).

Reported results relate only to performance at the time of calibration and are applicable only to the device reference in this report. The referenced instrument/device has been calibrated in accordance with norms of ISO/IEC 17025:2005(E) and ISO 10012, and as appropriate the norms of ANSI Z540.1.

REPORT OF TEMPERATURE VALUES

Fixed Point	Defined Temperature (°C)	Thermometer Resistance (Ω)	Expanded Uncertainty ±(°C)
Comparison	-195.6935	4.77580	0.0096
TP-Hg	-38.8301	21.39949	0.0026
TPW	0.0100	25.34967	0.0019
FP-In	156.5990	40.80610	0.0038
FP-Sn	231.9231	47.97775	0.0079
FP-Zn	419.5236	65.11555	0.0091

All temperature values reported in this document are according with the International Temperature Scale of 1990 (ITS-90)

The resistance of this thermometer were taken with the following AC bridge:

Manufacturer: ISOTECH

S/N: 15-P1131ITL361949/1

Model: Micro K 70

ID Number: CTL-I-081

Current (mA): 1.00

The following values were determined for the coefficients using the pertinent deviation function of the ITS-90

Scale > TPW

$$W-Wry = a(W-1) + b(W-1)^2$$

Where:

$$a8 = -1.895215E-04$$

$$b8 = 3.536082E-05$$

Scale < TPW

$$W-Wry = a(W-1) + b[(W-1)] \ln W$$

$$a4 = -8.153253E-05$$

$$b4 = -9.291425E-07$$

The resistance of this thermometer at 273.16 K is:

$$R_{AP} = 25.3497 \Omega$$

Environmental Conditions

Temperature: 25.2 °C

Humidity:

30 %RH

COMMENTS: N/A

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Procedure Used: OPT-002

Standards Used:

Description:	TPW Cell	SPRT
Manufactured:	Ponds Engineering	FLUKE
Model:	A-11	5699
Serial Number:	1269	0686

SPRT						Test Number: TEM18-1056B		
ACCUMAC			ID Number: N/A			Serial Number: 1621255		
$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt	$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt	$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt
-196	4.74221	0.10967	-150	9.76835	0.10769	-104	14.65313	0.10485
-195	4.85189	0.10977	-149	9.87605	0.10762	-103	14.75798	0.10480
-194	4.96166	0.10985	-148	9.98366	0.10754	-102	14.86278	0.10476
-193	5.07151	0.10992	-147	10.09120	0.10747	-101	14.96754	0.10471
-192	5.18143	0.10997	-146	10.19867	0.10739	-100	15.07225	0.10466
-191	5.29140	0.11001	-145	10.30606	0.10732	-99	15.17691	0.10462
-190	5.40142	0.11004	-144	10.41337	0.10724	-98	15.28153	0.10457
-189	5.51146	0.11006	-143	10.52062	0.10717	-97	15.38610	0.10452
-188	5.62152	0.11007	-142	10.62779	0.10710	-96	15.49062	0.10448
-187	5.73160	0.11008	-141	10.73489	0.10703	-95	15.59510	0.10443
-186	5.84167	0.11007	-140	10.84191	0.10696	-94	15.69954	0.10439
-185	5.95174	0.11005	-139	10.94887	0.10689	-93	15.80393	0.10435
-184	6.06180	0.11003	-138	11.05575	0.10682	-92	15.90827	0.10430
-183	6.17183	0.11000	-137	11.16257	0.10675	-91	16.01257	0.10426
-182	6.28183	0.10997	-136	11.26932	0.10668	-90	16.11683	0.10421
-181	6.39180	0.10993	-135	11.37600	0.10661	-89	16.22104	0.10417
-180	6.50173	0.10989	-134	11.48261	0.10655	-88	16.32522	0.10413
-179	6.61161	0.10984	-133	11.58916	0.10648	-87	16.42935	0.10409
-178	6.72145	0.10978	-132	11.69564	0.10642	-86	16.53343	0.10404
-177	6.83123	0.10973	-131	11.80206	0.10635	-85	16.63748	0.10400
-176	6.94096	0.10967	-130	11.90841	0.10629	-84	16.74148	0.10396
-175	7.05063	0.10961	-129	12.01470	0.10623	-83	16.84544	0.10392
-174	7.16023	0.10954	-128	12.12093	0.10616	-82	16.94936	0.10388
-173	7.26977	0.10947	-127	12.22709	0.10610	-81	17.05324	0.10384
-172	7.37925	0.10940	-126	12.33319	0.10604	-80	17.15708	0.10380
-171	7.48865	0.10933	-125	12.43923	0.10598	-79	17.26088	0.10376
-170	7.59798	0.10926	-124	12.54521	0.10592	-78	17.36464	0.10372
-169	7.70724	0.10918	-123	12.65113	0.10586	-77	17.46836	0.10368
-168	7.81643	0.10911	-122	12.75700	0.10580	-76	17.57203	0.10364
-167	7.92554	0.10903	-121	12.86280	0.10575	-75	17.67567	0.10360
-166	8.03457	0.10896	-120	12.96855	0.10569	-74	17.77927	0.10356
-165	8.14352	0.10888	-119	13.07424	0.10563	-73	17.88284	0.10352
-164	8.25240	0.10880	-118	13.17987	0.10558	-72	17.98636	0.10348
-163	8.36120	0.10872	-117	13.28545	0.10552	-71	18.08984	0.10345
-162	8.46992	0.10864	-116	13.39097	0.10547	-70	18.19329	0.10341
-161	8.57856	0.10856	-115	13.49644	0.10541	-69	18.29669	0.10337
-160	8.68712	0.10848	-114	13.60185	0.10536	-68	18.40006	0.10333
-159	8.79560	0.10840	-113	13.70721	0.10531	-67	18.50340	0.10329
-158	8.90400	0.10832	-112	13.81252	0.10525	-66	18.60669	0.10326
-157	9.01232	0.10824	-111	13.91777	0.10520	-65	18.70995	0.10322
-156	9.12056	0.10816	-110	14.02297	0.10515	-64	18.81317	0.10318
-155	9.22872	0.10808	-109	14.12812	0.10510	-63	18.91635	0.10315
-154	9.33681	0.10800	-108	14.23322	0.10505	-62	19.01950	0.10311
-153	9.44481	0.10793	-107	14.33827	0.10500	-61	19.12261	0.10307
-152	9.55274	0.10785	-106	14.44327	0.10495	-60	19.22568	0.10304
-151	9.66058	0.10777	-105	14.54822	0.10490	-59	19.32872	0.10300

SPRT						Test Number: TEM18-1056B		
ACCUMAC			ID Number: N/A			Serial Number: 1621255		
$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt	$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt	$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt
-58	19.43172	0.10297	-12	24.13324	0.10145	34	28.76790	0.10003
-57	19.53469	0.10293	-11	24.23470	0.10142	35	28.86793	0.10000
-56	19.63761	0.10289	-10	24.33612	0.10139	36	28.96793	0.09997
-55	19.74051	0.10286	-9	24.43751	0.10136	37	29.06790	0.09994
-54	19.84337	0.10282	-8	24.53887	0.10133	38	29.16784	0.09991
-53	19.94619	0.10279	-7	24.64021	0.10130	39	29.26774	0.09988
-52	20.04898	0.10275	-6	24.74151	0.10127	40	29.36762	0.09985
-51	20.15173	0.10272	-5	24.84278	0.10124	41	29.46747	0.09982
-50	20.25445	0.10268	-4	24.94401	0.10121	42	29.56728	0.09979
-49	20.35714	0.10265	-3	25.04522	0.10118	43	29.66707	0.09975
-48	20.45979	0.10262	-2	25.14640	0.10115	44	29.76682	0.09972
-47	20.56240	0.10258	-1	25.24755	0.10112	45	29.86655	0.09969
-46	20.66498	0.10255	0	25.34866	0.10107	46	29.96624	0.09966
-45	20.76753	0.10251	1	25.44973	0.10104	47	30.06590	0.09963
-44	20.87004	0.10248	2	25.55078	0.10101	48	30.16554	0.09960
-43	20.97252	0.10245	3	25.65179	0.10098	49	30.26514	0.09957
-42	21.07497	0.10241	4	25.75277	0.10095	50	30.36471	0.09954
-41	21.17738	0.10238	5	25.85372	0.10092	51	30.46425	0.09951
-40	21.27976	0.10235	6	25.95464	0.10089	52	30.56376	0.09948
-39	21.38210	0.10231	7	26.05553	0.10086	53	30.66324	0.09945
-38	21.48441	0.10228	8	26.15639	0.10083	54	30.76269	0.09942
-37	21.58669	0.10225	9	26.25721	0.10080	55	30.86211	0.09939
-36	21.68894	0.10221	10	26.35801	0.10077	56	30.96150	0.09936
-35	21.79115	0.10218	11	26.45877	0.10073	57	31.06086	0.09933
-34	21.89333	0.10215	12	26.55951	0.10070	58	31.16019	0.09930
-33	21.99548	0.10212	13	26.66021	0.10067	59	31.25949	0.09927
-32	22.09760	0.10208	14	26.76089	0.10064	60	31.35875	0.09924
-31	22.19968	0.10205	15	26.86153	0.10061	61	31.45799	0.099207
-30	22.30173	0.10202	16	26.96214	0.10058	62	31.55720	0.09918
-29	22.40375	0.10199	17	27.06272	0.10055	63	31.65637	0.09915
-28	22.50574	0.10196	18	27.16327	0.10052	64	31.75552	0.09912
-27	22.60769	0.10192	19	27.26379	0.10049	65	31.85463	0.09909
-26	22.70962	0.10189	20	27.36428	0.10046	66	31.95372	0.09905
-25	22.81151	0.10186	21	27.46474	0.10043	67	32.05277	0.09902
-24	22.91337	0.10183	22	27.56516	0.10040	68	32.15180	0.09899
-23	23.01520	0.10180	23	27.66556	0.10037	69	32.25079	0.09896
-22	23.11699	0.10177	24	27.76593	0.10034	70	32.34976	0.09893
-21	23.21876	0.10173	25	27.86626	0.10030	71	32.44869	0.09890
-20	23.32049	0.10170	26	27.96657	0.10027	72	32.54759	0.09887
-19	23.42219	0.10167	27	28.06684	0.10024	73	32.64647	0.09884
-18	23.52387	0.10164	28	28.16708	0.10021	74	32.74531	0.09881
-17	23.62551	0.10161	29	28.26730	0.10018	75	32.84412	0.09878
-16	23.72712	0.10158	30	28.36748	0.10015	76	32.94290	0.09875
-15	23.82869	0.10155	31	28.46763	0.10012	77	33.04165	0.09872
-14	23.93024	0.10152	32	28.56775	0.10009	78	33.14038	0.09869
-13	24.03176	0.10149	33	28.66784	0.10006	79	33.23907	0.09866

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80	33.33773	0.09863	126	37.84346	0.09724	172	42.28560	0.09587
81	33.43636	0.09860	127	37.94070	0.09721	173	42.38147	0.09584
82	33.53496	0.09857	128	38.03791	0.09718	174	42.47730	0.09581
83	33.63353	0.09854	129	38.13510	0.09715	175	42.57311	0.09578
84	33.73207	0.09851	130	38.23225	0.09712	176	42.66889	0.09575
85	33.83058	0.09848	131	38.32937	0.09709	177	42.76463	0.09572
86	33.92905	0.09845	132	38.42646	0.09706	178	42.86035	0.09569
87	34.02750	0.09842	133	38.52352	0.09703	179	42.95604	0.09566
88	34.12592	0.09839	134	38.62056	0.09700	180	43.05170	0.09563
89	34.22431	0.09836	135	38.71756	0.09697	181	43.14732	0.09560
90	34.32267	0.09833	136	38.81453	0.09694	182	43.24292	0.09557
91	34.42100	0.09830	137	38.91147	0.09691	183	43.33849	0.09554
92	34.51929	0.09827	138	39.00839	0.09688	184	43.43403	0.09551
93	34.61756	0.09824	139	39.10527	0.09685	185	43.52954	0.09548
94	34.71580	0.09821	140	39.20212	0.09682	186	43.62502	0.09545
95	34.81400	0.09818	141	39.29894	0.09679	187	43.72046	0.09542
96	34.91218	0.09815	142	39.39574	0.09676	188	43.81588	0.09539
97	35.01033	0.09812	143	39.49250	0.09673	189	43.91127	0.09536
98	35.10844	0.09809	144	39.58923	0.09670	190	44.00663	0.09533
99	35.20653	0.09806	145	39.68593	0.09667	191	44.10196	0.09530
100	35.30459	0.09803	146	39.78261	0.09664	192	44.19727	0.09527
101	35.40261	0.09800	147	39.87925	0.09661	193	44.29254	0.09524
102	35.50061	0.09797	148	39.97586	0.09658	194	44.38778	0.09521
103	35.59857	0.09794	149	40.07245	0.09655	195	44.48299	0.09518
104	35.69651	0.09790	150	40.16900	0.09652	196	44.57817	0.09515
105	35.79441	0.09787	151	40.26552	0.09649	197	44.67332	0.09512
106	35.89229	0.09784	152	40.36201	0.09646	198	44.76845	0.09509
107	35.99013	0.09781	153	40.45848	0.09643	199	44.86354	0.09506
108	36.08795	0.09778	154	40.55491	0.09640	200	44.95860	0.09503
109	36.18573	0.09775	155	40.65131	0.09637	201	45.05364	0.09500
110	36.28348	0.09772	156	40.74769	0.09634	202	45.14864	0.09497
111	36.38121	0.09769	157	40.84403	0.09631	203	45.24362	0.09494
112	36.47890	0.09766	158	40.94034	0.09628	204	45.33856	0.09492
113	36.57657	0.09763	159	41.03663	0.09625	205	45.43348	0.09489
114	36.67420	0.09760	160	41.13288	0.09622	206	45.52836	0.09486
115	36.77180	0.09757	161	41.22911	0.09619	207	45.62322	0.09483
116	36.86938	0.09754	162	41.32530	0.09616	208	45.71804	0.09480
117	36.96692	0.09751	163	41.42147	0.09613	209	45.81284	0.09477
118	37.06443	0.09748	164	41.51760	0.09610	210	45.90761	0.09474
119	37.16192	0.09745	165	41.61370	0.09607	211	46.00234	0.094708
120	37.25937	0.09742	166	41.70978	0.09604	212	46.09705	0.09468
121	37.35679	0.09739	167	41.80582	0.09602	213	46.19173	0.09465
122	37.45419	0.09736	168	41.90184	0.09599	214	46.28638	0.09462
123	37.55155	0.09733	169	41.99782	0.09596	215	46.38100	0.09459
124	37.64888	0.09730	170	42.09378	0.09593	216	46.47559	0.09456
125	37.74618	0.09727	171	42.18971	0.09590	217	46.57015	0.09453

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ACCUMAC			ID Number: N/A			Serial Number: 1621255		
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218	46.66468	0.09450	264	50.98120	0.09315	310	55.23557	0.09180
219	46.75918	0.09447	265	51.07434	0.09312	311	55.32737	0.09177
220	46.85365	0.09444	266	51.16746	0.09309	312	55.41914	0.09174
221	46.94809	0.09441	267	51.26055	0.09306	313	55.51088	0.09171
222	47.04250	0.09438	268	51.35361	0.09303	314	55.60259	0.09168
223	47.13689	0.09435	269	51.44663	0.09300	315	55.69427	0.09165
224	47.23124	0.09432	270	51.53963	0.09297	316	55.78592	0.09162
225	47.32556	0.09429	271	51.63260	0.09294	317	55.87754	0.09159
226	47.41986	0.09426	272	51.72554	0.09291	318	55.96914	0.09156
227	47.51412	0.09424	273	51.81845	0.09288	319	56.06070	0.09153
228	47.60836	0.09421	274	51.91134	0.09285	320	56.15224	0.09151
229	47.70256	0.09418	275	52.00419	0.09282	321	56.24374	0.09148
230	47.79674	0.09415	276	52.09701	0.09279	322	56.33522	0.09145
231	47.89088	0.09412	277	52.18981	0.09276	323	56.42667	0.09142
232	47.98500	0.09409	278	52.28257	0.09274	324	56.51808	0.09139
233	48.07909	0.09406	279	52.37531	0.09271	325	56.60947	0.09136
234	48.17315	0.09403	280	52.46801	0.09268	326	56.70083	0.09133
235	48.26718	0.09400	281	52.56069	0.09265	327	56.79216	0.09130
236	48.36117	0.09397	282	52.65334	0.09262	328	56.88346	0.09127
237	48.45514	0.09394	283	52.74595	0.09259	329	56.97474	0.09124
238	48.54908	0.09391	284	52.83854	0.09256	330	57.06598	0.09121
239	48.64299	0.09388	285	52.93110	0.09253	331	57.15719	0.09118
240	48.73688	0.09385	286	53.02363	0.09250	332	57.24838	0.09115
241	48.83073	0.09382	287	53.11613	0.09247	333	57.33953	0.09113
242	48.92455	0.09379	288	53.20860	0.09244	334	57.43066	0.09110
243	49.01834	0.09376	289	53.30105	0.09241	335	57.52175	0.09107
244	49.11211	0.09373	290	53.39346	0.09238	336	57.61282	0.09104
245	49.20584	0.09370	291	53.48584	0.09235	337	57.70386	0.09101
246	49.29954	0.09368	292	53.57820	0.09233	338	57.79487	0.09098
247	49.39322	0.09365	293	53.67052	0.09230	339	57.88584	0.09095
248	49.48687	0.09362	294	53.76282	0.09227	340	57.97679	0.09092
249	49.58048	0.09359	295	53.85509	0.09224	341	58.06771	0.09089
250	49.67407	0.09356	296	53.94732	0.09221	342	58.15861	0.09086
251	49.76763	0.09353	297	54.03953	0.09218	343	58.24947	0.09083
252	49.86115	0.09350	298	54.13171	0.09215	344	58.34030	0.09080
253	49.95465	0.09347	299	54.22386	0.09212	345	58.43110	0.09077
254	50.04812	0.09344	300	54.31598	0.09209	346	58.52188	0.09075
255	50.14156	0.09341	301	54.40807	0.09206	347	58.61262	0.09072
256	50.23497	0.09338	302	54.50013	0.09203	348	58.70334	0.09069
257	50.32835	0.09335	303	54.59216	0.09200	349	58.79403	0.09066
258	50.42170	0.09332	304	54.68417	0.09197	350	58.88468	0.09063
259	50.51503	0.09329	305	54.77614	0.09194	351	58.97531	0.09060
260	50.60832	0.09326	306	54.86809	0.09192	352	59.06591	0.09057
261	50.70158	0.09323	307	54.96000	0.09189	353	59.15648	0.09054
262	50.79482	0.09320	308	55.05189	0.09186	354	59.24702	0.09051
263	50.88802	0.09318	309	55.14374	0.09183	355	59.33753	0.09048

SPRT ACCUMAC						Test Number: TEM18-1056B Serial Number: 1621255		
ID Number: N/A								
$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt	$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt	$t_{90}/^{\circ}\text{C}$	R / Ω	dR/dt
356	59.42801	0.09045	402	63.55846	0.08910			
357	59.51847	0.09042	403	63.64757	0.08907			
358	59.60889	0.09039	404	63.73664	0.08904			
359	59.69928	0.09036	405	63.82568	0.08901			
360	59.78965	0.09034	406	63.91469	0.08898			
361	59.87998	0.09031	407	64.00368	0.08895			
362	59.97029	0.09028	408	64.09263	0.08892			
363	60.06056	0.09025	409	64.18156	0.08890			
364	60.15081	0.09022	410	64.27045	0.08887			
365	60.24103	0.09019	411	64.35932	0.08884			
366	60.33122	0.09016	412	64.44816	0.08881			
367	60.42138	0.09013	413	64.53696	0.08878			
368	60.51151	0.09010	414	64.62574	0.08875			
369	60.60161	0.09007	415	64.71449	0.08872			
370	60.69168	0.09004	416	64.80321	0.08869			
371	60.78172	0.09001	417	64.89190	0.08866			
372	60.87173	0.08998	418	64.98055	0.08863			
373	60.96172	0.08995	419	65.06918	0.08860			
374	61.05167	0.08992	420	65.15778	0.08857			
375	61.14160	0.08990	421	65.24636	0.08854			
376	61.23149	0.08987	422	65.33490	0.08851			
377	61.32136	0.08984	423	65.42341	0.08848			
378	61.41120	0.08981	424	65.51189	0.08845			
379	61.50100	0.08978	425	65.60034	0.09380			
380	61.59078	0.08975						
381	61.68053	0.08972						
382	61.77025	0.08969						
383	61.85994	0.08966						
384	61.94960	0.08963						
385	62.03923	0.08960						
386	62.12883	0.08957						
387	62.21840	0.08954						
388	62.30795	0.08951						
389	62.39746	0.08948						
390	62.48695	0.08945						
391	62.57640	0.08943						
392	62.66583	0.08940						
393	62.75522	0.08937						
394	62.84459	0.08934						
395	62.93393	0.08931						
396	63.02323	0.08928						
397	63.11251	0.08925						
398	63.20176	0.08922						
399	63.29098	0.08919						
400	63.38017	0.08916						
401	63.46933	0.08913						